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Viscous Objects. The Uneven Resistances of Repair

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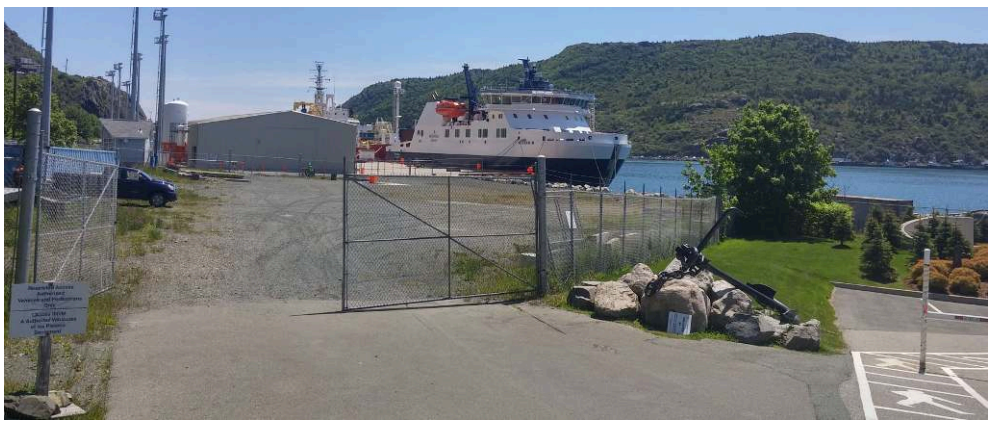
Opening image.



MV Veteran undergoing testing during repairs in St. John's, Newfoundland on June 25, 2016
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The island of Newfoundland, Canada, is a remote place. The most eastern point in North America, it is surrounded by the cold waters of the North Atlantic Ocean. It is closer to a small French overseas community called St. Pierre and Miquelon than it is to the rest of Canada. An island of islands, ferries are the sole form of transportation

available to many satellite islands dotting Newfoundland's coastline as well as shortcuts between communities connected by roads that must arc around bays and a complex shoreline geography. In Newfoundland, ferries are more than essential services; they are the lifelines sustaining its remote, island communities (Persaud 2018). Any prolonged breakdowns and delays in ferry services can hinder residents' access to mainland-based services for health, food, and fuel and detrimentally affect these islands' small, seasonally based economies. Consequently, keeping ferries running is of utmost importance. Here, we focus on one of these ferries, the new MV Veteran, as a sociotechnical system. The Veteran was put into service on December 20, 2015, but was out of working order for 144 of its first 199 expected days of service. The repeated and protracted breakdowns of the Veteran make it an excellent case study for looking at multiple and varied acts of maintenance and repair in a complex and socially relevant technical system with high stakes.

1 On April 13, 2016, the Government of Newfoundland and Labrador's Department of Transportation and Works (DTW) released yet another status update of the repairs to the MV Veteran following its fourth breakdown involving its propulsion system in a span of five months:

> "Necessary parts for the [port thruster] repairs will arrive the first week of May and repairs are anticipated to take three to four weeks to complete. In addition, Rolls Royce Finland is exploring potential modifications to prevent further issues with the thruster ...The vessel was relocated to St. John's following the mechanical failure of the port thruster. Throughout the inspection and repair work, Damen and Rolls Royce are also working to determine the root cause of the failure of the thruster." (DTW 2016a)

2 Breakdowns such as this, where uncertainty about its causes and the need to relocate technologies to central hubs, are commonplace amongst complex or 'fixed' technologies (as opposed to 'fluid' technologies, see de Laet & Mol 2000) that are designed, both inadvertently and deliberately, in ways which can hinder local repairs. Akrich, for instance, characterizes photo-electric lighting kits designed in France for use in Africa as fixed technologies which imposed an "embargo on local repairs" attributable to their inaccessible design and the internal complexities of the electrical kits' wiring that required external technicians for their repair (Akrich 1992: 210). As a form of infrastructure, the technical composition and repair life of the MV Veteran significantly differs from those of consumer goods commonly examined in studies of repair practices such as mobile phones. Increasingly, the enhanced technical (especially digital) capacities of new infrastructure are accompanied by greater internal complexities requiring the mobilization of external sites and experts who can maneuver those complexities (Hughes 1983; Perrow 1999). As a result, fixed infrastructural systems implemented today are presented solely as the domain of experts who have the requisite knowledge or resources to address breakdowns to these systems.

3 Here, we make the case that many of the core complexities of repairing infrastructural breakdowns are not only technical in nature, but deeply procedural and spatial. This in itself is not new, but the remote location of the sociotechnical system and its mix of both fixed and fluid, mutable and immutable social and technical aspects adds some nuance to the literature we draw upon. The MV Veteran features several technical subsystems of varying complexity and fixity, leading its manufacturer Damen

Shipyards to include warranty coverage to better address unforeseen breakdowns. This warranty adds to the complexity to the processes of maintenance and repair.

4 Our analysis of the attempts made by Damen to condition the temporal and spatial characteristics of ferry breakdowns through their warranty is based upon post-facto document analysis and elements of ethnographic field work. Through five general information requests made to Newfoundland and Labrador's Access to Information and Protection of Privacy (ATIPP), we obtained government emails, communications, and meeting minutes concerning the breakdown and repair of the MV Veteran. The ATIPP requests were supplemented with the collection and examination of media publications related to the MV Veteran. The records from the ATIPP requests and media publications were sorted and thematically coded based upon recurring themes in the documents concerning the ferry's breakdowns and repairs. Additionally, we incorporate elements of ethnographic field work having conducted interviews with former and current employees of DTW assigned to the Fogo Island-Change Islands ferry service. Unlike prior studies of repair which observe repair-in-action, our ATIPP requests and interviews were conducted after employees and manufacturers had completed their repairs. Therefore, we do not document the messiness of repair in practice or repair as a form of verbal-material interface as we did not observe immediate repairs. Rather, our data allows us to gesture to the greater technical, procedural, and spatial complexities involved in coordinating and performing such repairs.

5 In doing so, we demonstrate there are multiple gradations of resistance or 'viscosity' — rather than fixedness— the MV Veteran presents to its actors in their attempts to resolve breakdowns through practices of maintenance and repair. Overall, we claim that the importance of the term viscosity in the sociotechnical lexicon is not to demark a halfway point between fluid and fixed, mobile and immobile, but to point out how a single object like a ferry can be all of these things, *unevenly*, at once.

Not fluid or fixed, but viscous

We join other scholars in the effort to characterize the space between structured and intended versus unanticipated and unintended processes for working with technologies (Adams *et al.* 2009, Liboiron 2017, Soleil Archambault 2011, Star 1990). In the classic case of the Zimbabwe bush pump, de Laet & Mol (2000) emphasize the 'fluidity' of the pump as the rationale for its success in different contexts. The pump's design allows it to easily adapt to different locations and environmental contexts, including cases where parts may be substituted or changed, but the pump's functionality (its ability to pump water) remains intact. Here, the localized adaptations, interchangeability, and flexibility of the bush pump are positioned as strengths relative to 'immutable mobiles' characterized by the immutability of a form to allow the circulation of its content or 'fixed' technologies which may be more resistant to change and impose their designer's intentions upon their users (Latour 1987). Technology theorist Madeleine Akrich uses the term 'script' to describe how designers imagine users "with specific tastes, competences, motives, aspirations, political prejudices, etc." (Akrich 1992: 208) including capacities and abilities to repair, "and inscribe these representations in the technical content of the new artifact. As a result, artifacts contain a script and this script prescribes (in a more or less coercive manner) what users have to do (or not do)

to produce the envisioned functioning of the technological artifact" (van Oost 2003: 195). In each case —immutable mobiles, fixed technologies, and scripts— the ability to deviate from intended or designed routes of engagement are curtailed.

6 Our case of the MV Veteran, a new passenger-car ferry operating at Fogo Island-Change Islands (FICI), on the island of Newfoundland, Canada, presents a situation where these existing terminologies, while helpful, do not fully capture the characteristics of the technical relationships between the technology, its users, its repairers, and its operational context. The MV Veteran certainly features 'fixed' systems such as its Rolls Royce azimuth thrusters, which require teams of experts to fix, given the catastrophic consequences that unchecked modifications may yield. Yet, the ferry features more 'fluid' systems such as its passenger elevator and internal plumbing which, are more readily modifiable and modular in their composition. Furthermore, the MV Veteran's size means that it cannot be easily moved to other locations for third-party repair, but certain components may be repaired *in situ* and the ferry remains mobile in ways that make it unlike the fixed capital of other kinds of infrastructure such as roads or bridges, yet not as mobile as an immutable mobile. This is not because it literally moves or not; here, fixity and immutability refer to how a technical object can be mechanically manipulated for new purposes, relations, and effects by local actors. Therefore, we propose that the ferry can be better understood as a class of technical object that is neither as 'fluid' as the bush-pump (de Laet & Mol 2000) or a public bus (Beisel & Schneider 2012), nor quite as 'fixed' as infrastructures embedded in landscapes such as a shipping canal (Carse 2014), or even as immutable as books (Latour 1987). We suggest it is more helpful to think of the MV Veteran in terms of its 'viscosity'.

7 Viscosity defines a "state of being thick, sticky, and semi-fluid in consistency, due to internal friction" (OED 2019). More than a material halfway point between fluidity and fixedness, the term viscous points to an always-already present 'internal friction' where multiple agencies (of objects, of people, of places, of warranties) rub up against one another to characterize relations (Basu 2017, Carr & Gibson 2016, Ingold 2012, Klocker *et al.* 2018). Our use of viscosity is meant to help conceptualize gradations in resistance, as a specific genre of relationality, between an object and the practices of repair following breakdowns. Frequently, there are "contradictions and slippage between [the] planning and enactment" of infrastructure that arise from imagined versus enacted users, the integration of new infrastructure with pre-existing infrastructural networks, and the unique spatialities and temporalities of place (Massey 2005, Smith 2016: 165, Star & Ruhleder 1996, Watts 2014). As technology and society scholars Susan Leigh Star and Karen Ruhleder (1996: 113) observe, "infrastructure is built on an installed base. Infrastructure does not grow *de novo*; it wrestles with the inertia of the installed base and inherits strengths and limitations from that base" as infrastructures of different forms and ages must co-exist and operate simultaneously in place. But these are not only technical frictions - they are also contextual and procedural, built out of standards, legacies of adaptation, shifting social norms and political economies, and cultural imperatives and their work arounds (Bowker & Star 2000; Gitelman 2014).

8 Infrastructures like the MV Veteran are developed with their designer's specific assumptions and representations of their envisioned operational context during the planning and developmental stages (Akrich 1992, Oudshoorn & Pinch 2003, Ureta 2014).

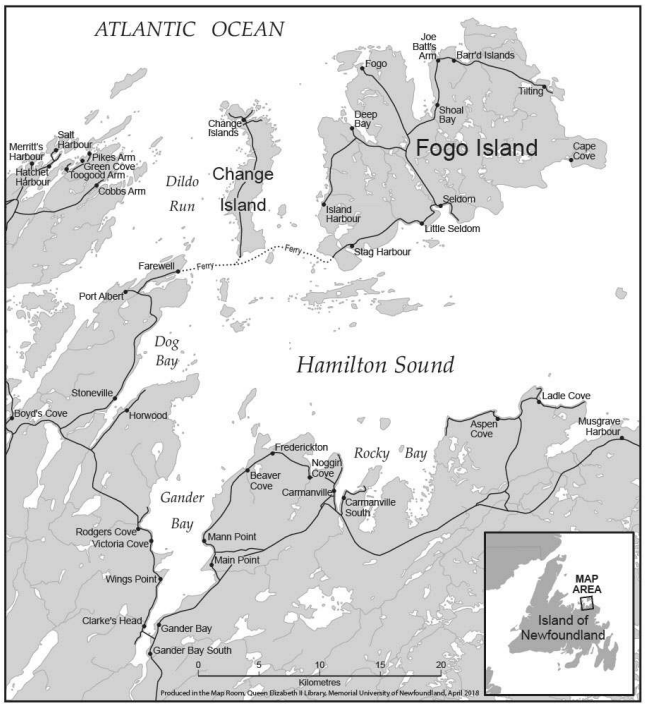
These assumptions are rarely, if ever, a match for their users' needs or place-based contexts, necessitating localized modifications, workarounds, and adaptations for infrastructure to perform as required (Barnes 2017, Bowker & Star 2000, Smith 2016). Barnes (2017) for instance, highlights the efforts undertaken by rural Egyptian farmers to modify irrigation channels by adding large, animal powered water wheels to improve water flow to crops as the state's default flow rate proves inadequate. In such cases, the introduction of infrastructure frequently reveals operational shortsightedness and limitations as its successful integration is dependent upon local modifications to align it with user practices in place.

9 Through recounting the breakdowns and repairs of the MV Veteran, we contend that the notion of viscosity better grasps gradations in resistance-in-place presented by technical objects to the practices of repair and maintenance as they occur on the ground; the integral acts by which breakdowns are resolved and new technologies are reworked such that they may function in their new operating environments.

Situating the MV Veteran

The MV Veteran is the latest passenger-car ferry to serve the small, rural, remote, coastal 'outport' communities of Fogo Island and Change Islands (FICI), Newfoundland and Labrador, Canada. Such outport communities historically have seasonal economies almost entirely reliant upon family-based fisheries and merchant trading (Wright 2001). The islands are situated approximately 300 km northwest of the provincial capital, St. John's and are roughly a forty-five minute ferry ride from Newfoundland's north coast. The ferry service constitutes the sole continuously operating transportation link between these smaller island communities and main island of Newfoundland other than emergency air services that operate when the ferry is out of service and until a backup ferry can be procured. The islands have come to be defined by this service as the majority of residents, freight, and visitors will encounter the ferry at some point when travelling to and from the islands.

1. Map of Fogo Island and Change Islands, NL and surrounding region



Map courtesy of David Mercer, Public Services, Queen Elizabeth II Library, Memorial University of Newfoundland

10 The province's Department of Transportation and Works awarded a $50 million contract to Damen Shipyards Group, a Dutch shipbuilding and industrial conglomerate, to construct the MV Veteran to replace the previous ferry, the MV Earl W. Winsor, which as of 2018 had been in operation for forty-six years. Given the near total reliance on the ferry service, the MV Veteran was introduced to improve the reliability and capabilities of both the ferry and the islands' ferry service. Particularly, during the winter season as Newfoundland's North Coast is susceptible to the movement of southward arctic ice requiring the use of federally operated icebreakers[1].

The MV Veteran's Breakdowns

Between December 20, 2015, the MV Veteran's official introduction to the Fogo Island-Change Islands (FICI) service, and July 6, 2016, the ferry's propulsion system saw four breakdowns requiring it to be removed from active service. In all, these four breakdowns kept the new vessel out of service for 144 of its 199 expected days of service, over 70% of its time in Newfoundland until that point. The first two breakdowns involved the MV Veteran's diesel engines and were relatively short, lasting two days in late-December 2015 and five days in mid-January 2016, respectively. These diesel engine breakdowns were able to be resolved on site by external repair technicians from St. John's that travelled to Fogo.

11 On February 2, 2016, the MV Veteran's port-side thruster broke down due to a lack of lubrication to the thruster's bearings. The vessel travelled to and was dry-docked in St. John's, 300 km away, for diagnosis and repairs by Rolls Royce technicians and Damen

technicians which lasted six weeks. A few weeks after returning to service, on April 3, 2016, the vessel's starboard thruster failed in a similar fashion as the port thruster and the MV Veteran returned to St. John's again for repairs, which lasted thirteen weeks. The latter breakdown saw a period of extensive testing in St. John's post-repairs to ensure the modifications made were successful before the ferry returned to FICI.

12 During both thruster breakdowns, the ferry was subject to a what is called a root cause analysis to determine the source of the breakdowns. A root cause analysis is a structured, systemic approach to investigating incidents allowing for, "a deeper look into... work processes to determine the underlying cause of incidents" (ABS Consulting *et al.* 2008: 6). Data from all subsystems linked to the broken part or subsystem is analyzed to determine the initiating cause for a breakdown. The root cause analysis approach to breakdown fundamentally changes the character of repair work through the strict delegation of labour and roles during diagnosis, analysis, and modification stages. During root cause analyses led by Damen, the scale of additional actors' involvement is determined on a case-dependent basis per Damen's internal decision making. Given their respective knowledge, technical capabilities, and the part of subsystem that broke down, some actors may find themselves at the center of repair work or excluded altogether. For example, during the MV Veteran's repairs to its starboard thrusters described in the press release excerpt, the root cause analysis was led by Rolls Royce Finland with support from Damen, sidelining the ferry's crew.

13 In addition to the propulsion system's four breakdowns, the MV Veteran experienced regular, smaller mechanical and electrical incidents which did not require the vessel to be removed from service, but required the Department of Transportation and Works (DTW) to file warranty claims with Damen for repairs. By the end of August 2016, DTW had submitted an additional 81 warranty claims to Damen. These warranty claims were of varying severity ranging from minor incidents such as a damaged lifeboat flap (Claim 56) and salt ingress accumulation in the windows of the aft passenger lounge (Claim 48) to more prominent incidents such as the hoistable vehicle decks not locking (Claim 80) which can reduce the ferry's vehicular capacity (DTW 2016d).

14 Moreover, the MV Veteran experienced day-to-day incidents that did not require a formal warranty claim through DTW and Damen, but hindered daily operations and services. For instance, in July 2016, some of the toilets in the public washrooms onboard the ferry would cease to function so passengers were not able to use them while making the crossing (Bird 2016, DTW 2016d). The hoistable vehicle decks would not lower at one end at times, requiring cars to reverse off the functional side of the ramp rather than being able to drive through as they normally would, leading to service delays from increased disembarking times.

Viscosity and breakdown: Functionality in context

The classifications of these breakdowns ranging from severe enough to stop scheduled crossings and require warranty actions to those that disrupted, but did not cease regular use are significant regarding the characteristics of the MV Veteran as a viscous technical object. The MV Veteran comprises multiple subsystems and components which as a whole sustain the ferry's operations, but in the event of breakdown these are not equally weighted. Infrastructures, as Star and Ruhleder (1996) argue, become 'visible' upon breakdown. That is, their previously unacknowledged functions are

foregrounded in periods of failure implying a clear distinction between states of working or not working. However, the frequency and variability of the MV Veteran's breakdowns do not map onto a simple on or off, working or not working binary. Indeed, rather than a binary state or sliding 'continuum' between working or not working (Steinhardt 2016), the ferry's ability to operate exhibits a sticky, flickering character depending on the specifics of a particular malfunction and what constitutes functionality within the object's wider context (Denis & Pontille 2017a).

15 There are two distinct classes of breakdown at play based on judgements made by the Department of Transportation and Works (DTW), Damen, and ferry crew members. The first class of breakdown concerns the functionality of the MV Veteran as a whole within the greater context of the Fogo Island-Change Islands (FICI) ferry service and includes its more 'fixed' subsystems such as its thrusters, engines, and hydraulic vehicle ramps. Only breakdowns to these subsystems would stop the MV Veteran's daily crossings, as the ferry would be unable to load vehicles or move altogether.

16 Conversely, the second class concerns more 'fluid' subsystems and components that would not affect the MV Veteran's primary purpose of completing its scheduled crossings. These subsystems and components, if not functional, were deemed unlikely to interfere with the MV Veteran's fixed subsystems. The MV Veteran made crossings despite unresolved warranty claims and services breakdowns with multiple subsystems in varying states of working order. Frequently, these subsystems were either ignored during a day's service period and would be repaired during off-hours or they were addressed with temporary, ad hoc fixes made by the crew while the ferry was in service. A prominent example of this was detailed by the ferry's crew in an email to DTW regarding the passenger washroom's toilets:

> We are having more issues with toilets failing on board. Now we have five toilets out of service, all appearing to be failing in the same part, diaphragm on discharge valve. Three of the toilets out of service are in the women's washroom. We are now having to move toilets from crews quarters to keep a sufficient number of toilets functioning for passengers (MV Veteran Crew Member, July 14, 2016) (DTW 2016d: 149).

17 Some of the passenger toilets were made operational because of the interchangeability characteristic of fluid technologies as the crew could swap failing diaphragms in the passenger toilets for functional ones from their own quarters. Moreover, the failing toilets demonstrate a common occurrence concerning the MV Veteran as its actors collectively agree on the two distinct classes of breakdown at play. The lack of a fully operational passenger washroom is deemed to fall within the ferry's margin of safe operation amidst the possibility of transporting passengers who might need to use the washroom during crossings. This was permissible as "a sufficient number" of toilets were still working for passengers to use during the relatively short forty-five minute crossing (DTW 2016d: 149). Here, the differentiability and importance ascribed to the MV Veteran's breakdowns by DTW, Damen, and the ferry's crew reveals the contextually dependent "grades and shades of working" which constitute functionality on the FICI ferry service (de Laet & Mol 2000: 226).

18 In the latter cases, the MV Veteran appears to be a 'fluid' technical object, for it can fulfill its overall purpose while subsystems and components exhibit varying degrees of functionality. However, viscosity offers a texture to different types of fluidity that may be missed when they are grouped together. A primary concern articulated in Damen warranty language was the risk that un-warranted repairs to fluid systems posed to

fixed systems. In short, treating a technology as fluid could lead to catastrophic damage and danger (also see Perrow 1999). As Sanne (2014) observes, the improvisation and 'bricolage' (Lévi-Strauss 1966) characteristic of locally developed repairs with resources at hand risks increasing the vulnerability of other standardized subsystems. The local modifications may be successful for achieving functionality in the object's wider context, but there is the risk of unintended interactions with other standardized subsystems if local practitioners overlook how their modifications may affect those subsystems (Sanne 2014).

19 The situation is similar to Beisel and Schneider's (2012) case of the transformation of a decommissioned German ambulance following an accident into a Ghanaian tro-tro (public bus), where the weakened frame of the vehicle and mechanical state of its engine remains unknown post-accident and conversion. Despite the tro-tro sustaining its intended purpose and broader relations through moving people to and from their destinations and supporting the livelihoods of its owners, the physical state of the bus coupled with the operational context of tro-tros which are frequently overloaded with passengers and speed on Ghanaian roads mark the dangers that fluidity can present. This aspect of fluidity is often lost in theorizations of adapting or tweaking technologies via repair.

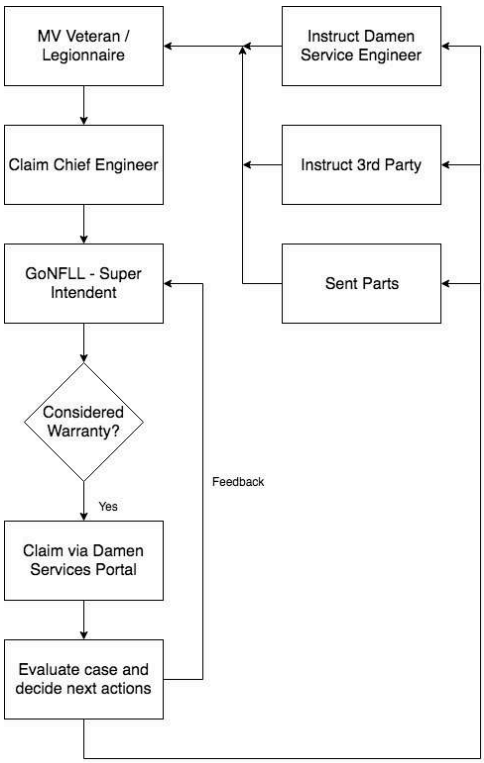
The viscosity of warranty-as-script

In addition to the technical systems in the MV Veteran and the people and groups who sought to repair them, a central player in our theorization of viscosity is the warranty. The repair and maintenance of the MV Veteran are governed by a comprehensive manufacturer warranty for the first year of its operations. Analytically, we treat the warranty as one of several central 'scripts' in Akrich's (1992) sense of the term. The warranty is a script by which the manufacturer attempts to minimize the ferry's relative fluidity through a logic of risk, where fluidity is understood as a source of danger when unchecked modifications and changes to certain subsystems may result in catastrophic failure. Akrich's (1992: 208) concept of 'scripts' describes how designers attempt to pre-determine the relationships between an object and its envisioned users during its development phase; she shows in her case of photoelectric lighting kits that, "it may be that no actors will come forward to play the roles envisaged by the designer. Or users may define quite different roles of their own". As such, scripts are no guarantee for successfully shaping user-object relations in advance, though they remain a source of friction or resistance and thus of viscosity. Scripts themselves can, and often do, breakdown and fail as it is impossible for designers to fully specify in advance how and under what conditions an object will be used.

20 As Jerome Denis and David Pontille (2017b: 1) suggest, even though Madeleine Akrich's notion of scripts "has been mostly mobilized to study how users are configured by designers, it is particularly useful to question the place ascribed to maintainers." Here, the MV Veteran's warranty functions as a 'script' (Akrich 1992) that determines, from Damen's point of view, who is able to repair and how they are able to repair. In doing so, the MV Veteran's warranty-as-script attempts to anticipate and condition future times and spacings of breakdown, as well as how those future breakdowns are to be addressed via maintenance and repair.

21 Warranty agreements offer partial or total coverage for any unforeseen accidents and incidents in which the manufacturer or an approved subcontractor will repair, and provide parts or a new product altogether within a prescribed term. Such warranty agreements are honoured so long as the stipulations or 'script' (Akrich 1992) outlined by manufacturers, such as using only authorized repair facilities or not modifying the product, are followed. Damen's warranty is a hierarchical, top-down approach towards managing the MV Veteran's breakdowns which Damen believes will limit miscommunications in repair action planning by centralizing communications through a chain of command. As Damen employees repeatedly emphasized in our source materials, breakdowns and operational glitches like those seen with the MV Veteran were a normal part of the shipbuilding process. In a sense, warranty agreements such as the one Damen provides serve as an acknowledgement of the resistances accompanying technologies and is their method of anticipating and even tempering the vessel's viscosity. At the same time, the warranty itself is a player in the MV Veteran's 'internal friction' where multiple agencies rub up against one another.

2. 'Warranty Call Handling' flow chart outlined in the Damen Services Warranty Introduction sent to DTW



DTW 2016b: 215

22 Damen assigns each new vessel to a warranty engineer and provides customers access to software to manage communications and part requisitions related to breakdowns. For the MV Veteran, warranty claims follow the literal script per the sequencing of the 'Warranty Call Handling' from the Warranty Introduction sent to the Department of Transportation and Works (DTW) upon the ferry's delivery and official handover (figure 2). The flowchart dictates the order of steps and responsibilities of the crew, from reporting a breakdown through a chain of command, the evaluation of those

reports and their (potential) transformation into formal warranty claims, and finally managing experts and parts to address claims.

23 However, in practice, the successful daily operation of the MV Veteran frequently necessitates immediate repairs for second class breakdowns performed by the crew such as those made to the passenger toilets when they swapped broken parts for those from their own cabin toilets. In such instances, the crew tries to expedite ferry repairs by making additional attempts at repair while a warranty claim is under review or the crew attempts to contact Damen employees and manufacturers directly for parts or instructions, thereby skipping portions of the warranty.

24 Moreover, some of the MV Veteran's crew articulate the warranty as a script that interferes with the development of local expertise onboard to deal with breakdowns as they occurred due to limitations the warranty places on tinkering. One case of the warranty constraining the crew not only in repairs, but the hierarchical relations set out between actors was detailed in an email exchange between the MV Veteran's Chief Engineer and DTW on March 23, 2016 regarding the port-side passenger elevator:

> Chief Engineer: ...Yesterday as an experiment I did increase the time to 280 sec in the port elevator and we almost got a full day [service] out of it. This morning however it was tripped out again.
> DTW: I will put a warranty claim in the system and Damen will be in contact with [Damen Representative].
> Chief Engineer: Is there nothing we can do to try and rectify the situation. Like I said increasing the time gave us a full day. I have since set back the time to original setting. Waiting for the whole warranty process does not seem like it is heading in the right direction. It will get the problem fixed but what we need to do is to develop the skill set on board for a quick response. Before you put the claim through let me give [Damen Employee] a call. I just need his number. I mean it could be something really simple like you need to bleed a little air out of the system...
> DTW: In keeping with the warranty procedures I have notified Damen so they are aware of the claim (DTW 2016c: 663-664).

25 Repair is a situated practice that often presents cases which fall outside of prescribed procedures or systemic learning requiring improvisation to keep things functioning (Callén & Criado 2016, Carr 2017, Graham & Thrift 2007, Jackson 2014, Sanne 2010). It involves processes that are "not simply planned or avoided through design, but instead actively produced and reconfigured through use" (Rosner & Ames 2014: 319). Thus, procedures for repair work prove difficult to standardize because of their contextual and emergent character (Dant 2010; Denis & Pontille 2015, Sormani *et al.* 2016, Tironi 2015). Manufacturers and designers often include guidelines and multiple fail-safes to prevent breakdowns (Perrow 1999), but the emergent character of breakdowns frequently requires the development of local solutions to repair accidents and incidents (Bowker & Star 2000, Mol *et al.* 2010).

26 Yet, even while the crew sometimes bucked against the protocols outlined in Damen's regimented flow of responsibilities, the warranty anticipates both the in-place and in-use nature of repair and the agency of the ferry crew. In Damen's 'Warranty Request Form' (figure 3), there is a specific space to record "Actions Taken" by the crew to initially correct a defect. This allows the MV Veteran's crew to address breakdowns where there may be opportunities for substitution with alternative parts or methods to achieve the same functionality as there was with the passenger toilets. This is particularly important given the centrality of the ferry to life on FICI, as well as the

remoteness of Newfoundland for shipping new parts that come from away. Both the crew and Damen attempt to first work towards fluidity and local abilities before the warranty directs efforts to repair to less local agents when determining the 'Actions Required' (figure 3).

3. 'Warranty Request Form' used by customers for warranty claims

WARRANTY REQUEST FORM (one subject per request form please)					
Vessel Name	:	Request No.	:		
Yard No.	:	Date	:		
Equipment	:	Model	:		
Maker	:	Serial No.	:		
Type	:	Running Hours	:		
Part	:	Part No.	:		
		Serial No.	:		
DESCRIPTION OF DEFECT					
ACTIONS TAKEN					
USED PARTS					
ACTIONS REQUIRED					
REQUEST MADE BY					
NAME		TITLE		DATE	

DTW 2016B, 217

27 Here, viscosity describes yet another friction between agencies as practices of repair performed (and the desire to perform them) locally by the vessel's crew and those expected externally by Damen as stipulated by the warranty both do and do not align, depending on the instance. As an example of viscosity, the warranty-as-script does define and enable desired relations, but in other cases it strains those same relations-spaces of technical repair are neither mainly fixed nor fluid, but a mix in different contexts, much like technical systems. The important nuance to the idea of viscosity here is that it does not only describe technical systems, but an organizing process that seeks to lubricate relations between different human actors.

Viscosity and place

Few standardized technical processes anticipate Newfoundland, Fogo Island and Change Islands (FICI) are even less of a concern (Brynjarsdóttir & Sengers 2009, Persaud 2018, Sengers 2011). Due to FICI's remoteness, "fresh vegetables are generally limited to the Newfoundland root vegetable staples: carrots, potatoes, rutabagas, onions, parsnips, and cabbage. Internet shopping is possible but is accompanied by prohibitive shipping costs" (Sengers 2011: 43). Things just do not arrive as quickly (or as freshly) as anticipated on the mainland. In providing the MV Veteran with warranty coverage, Damen anticipates that warranty claims will be resolvable within a reasonable time

period either by supplying parts or sending the required technicians to perform repairs. However, Damen's efforts to resolve claims are affected by the ferry's physically remote setting in outport Newfoundland.

28 Most warranties anticipate technological objects like cars. Cars are relatively easy to repair given their near ubiquity and their associated infrastructure of garages, roadways, and supply stores. That is, the installed infrastructural base facilitating the use of cars is extensive enough to facilitate timely repair work (Star & Ruhleder 1996) and may even come to define what "timely" means (Sengers 2011). If the required resources for car repairs are not locally available one may have to move the parts or the car to a different location, which may be an inconvenience, but is usually surmountable.

29 It is a fundamentally different proposition to move the engines and thrusters of an 81 meter-long passenger-car ferry. For a thruster replacement on the MV Veteran, one could physically move the thruster to Fogo Island, but would not be able to perform the repairs on site as Fogo lacks the necessary infrastructure for ferry repair such as a drydock or crane. The relative difficulty of arranging a situation appropriate to repairing the ferry is not strictly about the absolute size of the object, although this does have some role. The absence of a crane, for instance, shows that something smaller than the ferry itself strongly conditions the relative fluidity or fixity of it as an object. Likewise, shipping a small part to St. John's, the capital city 300 km from Fogo Island, means it will arrive much faster (though not "fast") than the same part being shipped to Fogo —much more time onto 300 km given the limited transportation infrastructure to Fogo. Remoteness, in the way we are using the term, is more about infrastructural relations than it is about distance.

30 Therefore, in addition to the relative fluidity and fixity of technical subsystems and the social arrangements of warranties, it is paramount to consider the ferry's positioning within broader power geometries of space. Geographer Doreen Massey (2005: 9) argues that space is the product of mutual, global and local, ever-changing relations "which are necessarily embedded material practices which have to be carried out" and manifest in place. Remoteness then is not an already-existing characteristic that makes material practices such as the physical movement of parts and technicians to repair some of the MV Veteran's breakdowns through Damen's mandatory warranty difficult; it means that the time and difficulty it takes for Damen to fulfill its warranty promises is what comes to constitute remoteness. In considering the viscosity of the MV Veteran, breakdowns and the work of repair not only concerns the innate, technical characteristics or composition of an object, but its positioning relative to sites enrolled in its repair. As geographers Lepawsky *et al.* (2017: 57) observe, repair work "makes connections between things, places and people. Sites are assembled through this work into geographies of repair."

31 The MV Veteran's inclusion of purpose-built subsystems such as its Volvo engine and Rolls Royce thrusters foreground the agencies and challenges to agencies associated with remoteness. Such challenges were evident in an exchange between Damen and the Department of Transportation and Works (DTW) regarding a Rolls Royce technician attempting to reach FICI before the MV Veteran's departure to St. John's in early April 2016 after the breakdown of its starboard thruster:

> Damen: ...RR [Rolls Royce] intends to perform vibration measurements during the voyage from Fogo to St. John's. The RR specialist is currently in Lewisporte and we

> require some assistance of the Government to get him to Fogo. Can you support us in this? (April 5, 2016).
> DTW: The Veteran departed Fogo Island this morning and the ETA [Estimated Time of Arrival] for St. John's is 1:00 am. We have space reserved at Pier 9 in St. John's Harbour. The RR technician did not make it on board. (April 7, 2016)
> Damen: Unfortunately, we missed some good opportunity to perform the valuable measurements in NL conditions to find the root cause of the failure. This was also necessary to start a thorough investigation of the current damage and decide if we need to dry-dock or not. Have you been in contact with RR-guys that they can travel back to St John's? I will inform RR about the ETA. (April 7, 2016) (DTW 2016c, 457-459).

32 Even though the Rolls Royce technician was relatively nearby in the mainland town of Lewisporte just over 100 km away, it was not possible for them to connect with the ferry before it departed Fogo Island for St. John's. This is because of a combination of Lewisporte being some distance away —an hour by car— and that the ferry was at Fogo Island, rather than docked at Farewell, the location where people board the ferry on Newfoundland bound for FICI. This meant the technician needed a ferry to get to the ferry. Alternatively, the technician could have used the expensive emergency air service (helicopter) or private marine transport (which requires social connections), but these were not accessible to them at the time.

33 In addition to moving technicians, moving parts and objects can pose a problem, especially given the purpose-built parts in the ferry that may have to be sent back to original manufacturing locations. As a Damen Representative explained, the expected repair timeline is greatly expanded in these conditions:

> As you might know, RR [Rolls Royce] is currently dismantling the upper gearbox [in St. John's, NL]. We have received a lead time of RR for all parts (same as Starboard) week 17 in Finland. It will take approximately one week to get the parts to St. John's and another one and a half to two weeks to repair the thruster. This is only for the repair and not for any modification of the thrusters... (Damen Representative, April 8, 2016) (DTW 2016c, 443).

34 Such instances demonstrate how the positioning of FICI and its limited infrastructural base and remoteness are central to the viscosity of the MV Veteran (Massey 2005, Star & Ruhleder 1996). The repair space is "constructed out of a particular constellation of social relations, meeting and weaving together at a particular locus" and is subject to the limitations imbued by the pre-existing infrastructural base of FICI (Massey 1991: 28). Remoteness contributes to the viscosity —uneven friction— of the ferry and is inseparable from repair work for they condition whether, how, and when these practices can occur.

35 Remoteness and the need to repair can then feed back into technical design and considerations. Given the reliance on internationally distributed facilities for repairs, some crew members commented that a greater degree of mechanical simplicity (as seen in their previous ferry, the MV Earl W. Winsor) would have largely negated the MV Veteran's problems. As in de Laet & Mol's (2000) case of the bush pump, the simplicity and adaptability of its design allowed for more timely repairs and a wider window of functionality within its operational context despite a lack of resources such as replacement parts. Similarly, a ferry more attuned to the unique spatialities and temporalities of FICI in its technical composition would have ensured that repairs could be performed locally as they would not require the mobilization of globally distributed sites for repairs. That is, the ferry's viscosity could have been tempered had it been

designed differently. It would alter the multiple resistances the ferry's actors encounter in their attempts to repair given FICI's peripheral positioning in the power geometries of space.

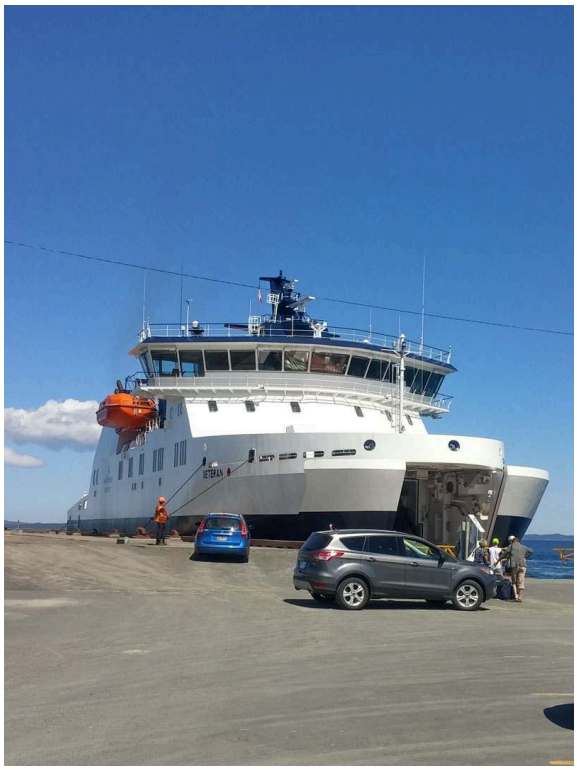
We claim that the term viscosity captures the uneven 'internal friction' of technical objects where agencies (of objects, of people, of places, of processes like warranties) overlap and rub up against one another in an uneven field of resistances. In recounting the breakdown and repair of the MV Veteran, we have outlined three areas in which viscosity characterizes the uneven agencies and relationships of technical repair work. Viscosity can be technical, such as having both fixed and fluid parts to one technology as seen in the MV Veteran's inclusion of toilets and Rolls Royce thrusters. It can be procedural, such as having a regimented script via a manufacturer warranty that still allows a space for local fixing and repairs to be performed. Finally, viscosity can be spatial, as in the case of remoteness, where having less of an infrastructural base can challenge the assumed fluidity of time, but is also not totally fixed as simple technologies can work well (or are anticipated to) in place.

36 Once again, we recall that the importance of the term viscosity in the socio-technical lexicon does not lie in pointing out an element halfway between fluid and fixed, mobile and immobile, but in showing how a single object such as a ferry can be all of these, unequally, at once. As such, it is likely that all technical objects have some degree of viscosity given that they will rarely be totally fluid or totally fixed, particularly as they move between contexts and encounter the unique temporalities and spatialities of place which frequently necessitate modification to approach their envisioned functionality. Viscosity then, presents a concept through which the multiple, shifting, and uneven agencies and resistances of technical objects and the practices of repair, which sustain technical objects, can be better articulated with attention to such nuances.

4. Additional photo

Crew added sign for passengers indicating how to open the door to the main deck following passengers being left on the vehicle deck.

5. Additional photo



MV VETERAN IN SERVICE AT FOGO ISLAND AND CHANGE ISLANDS FOLLOWING JUNE REPAIRS.
© D. Persaud

6. Additional photo

MV VETERAN DURING FINAL SEA TRIALS IN FIELD CONDITIONS AT FOGO ISLAND ON JULY 3, 2016.
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NOTES

1. The MV Veteran has the highest ice class for a passenger-car vessel (Ice Class 1AA) deemed suitable for winter navigation in sub-arctic waters.

ABSTRACTS

The MV Veteran, a seagoing car ferry constructed by the Dutch industrial conglomerate Damen Shipyards Group, connects the two small, rural outport communities of Fogo Island and Change Islands to the larger island of Newfoundland, Canada. Our paper examines the breakdowns of this new ferry and the repairs facilitated through its manufacturer’s warranty. In our analysis, we treat the warranty as a ‘script’ as something that both constrains and enables action and engenders resistances. The warranty anticipates and conditions both future times and spacings of breakdown and how those future breakdowns are to be addressed through activities such as maintenance and repair. In recounting the ferry’s breakdowns and repairs, we explore how the case of this ferry and its warranty in this particular place suggests a need to add to the analytical and conceptual repertoire for thinking about the breakdown and repair of technical objects. We suggest there is a need for supple enough concepts of breakdown and repair that they can deal with technical objects that are neither as ‘fluid’ as the classic example of a bush-pump nor quite as ‘fixed’ as infrastructures embedded in landscapes such as electrical grids or canals. Thus, we think with the notion of the ‘viscosity’ of technical objects. We claim that the importance of the term viscosity in the sociotechnical lexicon is not to demark a halfway point between fluid and fixed, mobile and immobile, but to point out how a single object like a ferry can be all of these things, *unevenly*, at once through characterizing its multiple resistances following breakdowns.

Le MV Veteran, un ferry-boat construit par le conglomérat industriel néerlandais Damen Shipyards Group, relie les deux petites collectivités rurales de l'avant-port de Fogo Island et de Change Islands à la grande île de Terre-Neuve, au Canada. Notre document examine les pannes de ce nouveau traversier et les réparations facilitées par la garantie du fabricant. Dans notre analyse, nous traitons la garantie comme un "script" qui à la fois contraint et permet l'action et engendre des résistances. La garantie prévoit et conditionne à la fois les moments de panne et les intervalles futurs entre les pannes ainsi que la façon dont ces pannes à venir doivent être traitées par des activités telles que l'entretien et les réparations. En relatant les pannes et les réparations du traversier, nous explorons comment le cas de ce traversier et sa garantie à cet endroit particulier suggère un besoin d'ajouter au répertoire analytique et conceptuel pour penser à la panne et à la réparation des objets techniques. Nous considérons qu'il est nécessaire de disposer de concepts suffisamment souples pour pouvoir traiter des objets techniques qui ne sont ni aussi "fluides" que l'exemple classique d'une pompe de brousse, ni aussi "fixes" que des infrastructures intégrées dans des paysages tels que des réseaux électriques ou des canaux. Ainsi, nous raisonnons avec la notion de "viscosité" des objets techniques. Nous affirmons que l'importance du terme viscosité dans le lexique sociotechnique ne consiste pas à marquer un point à mi-chemin entre fluide et fixe, mobile et immobile, mais à montrer comment un objet unique comme un ferry peut être tout cela à la fois et de façon inégale, en caractérisant ses multiples résistances après les pannes.

INDEX

Mots-clés: réparation, entretien, résistance, agence, infrastructure, Terre-Neuve, Canada
Keywords: repair, maintenance, resistance, agency, infrastructure, Newfoundland, Canada

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